Collaborative Decision Making Tools : A Comparative Study Based on Functionalities

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Abstract

This paper is on collaborative decision making issues. The study is on collaborative decision making tools. To do that, a state of the art of these tools supporting collaborative work in general and especially the tools supporting collaborative decision making process GDSS (Group Decision Support System) has been realized. A comparative study of these systems is made in order to highlight their strengths and their weaknesses. That aims to be a kind of tools selection guide, useful for mediated decision makers, in particular the facilitator.

Keywords

Collaborative Decision Making, GDSS, Electronic Meeting Tools, Meeting Software, Brainstorming tools.

1 Introduction

Decision making is a prolific research field for decades because of its relevancy not only in the research area, but also in all sizes organization (small, medium and large). Indeed, the success and even the durability of the actions of any organization depend on the decisions it make. If these decisions are good quality, then organization is going better.

Nowadays, the current economic context with the re-organization and merges Acquisition, and also the increasing complexity of problems to solve, decision making is no longer an activity involving just one or few people. Indeed, the decision making requires the participation of several stakeholders whose contributions are significant in final decision. This type of decision making is known as ***Collaborative Decision Making***.

Many studies revealed that collaboration is more and more important in organizations. Thus, according to Parametric Technology Corporation, the 2/3 of the engineers working time is devoted to collaborate (PTC, 2005). Another survey made by Frost & Sullivan agency found that: "36% of a company's performance was due to its collaboration index. This is more than twice the impact of a company's strategic orientation (16%) and more than five times the impact of market and technological turbulence influences (7%). This is a key finding because it empirically demonstrates that increased high-quality collaboration can improve business performance" (Frost & Sullivan, 2006).

In addition, the introduction of technologies of information and communication (TIC) promotes the move of decision making toward the collective decision making in the organizations. That integrated several perceptions (ways to observe) of the solution of problem through the contributions of different participants. This common and shared vision is beyond the individual vision of each participant and that gives rise better description of the problem (Adla, 2010).

From above, the relevance of collaborative decision making and its impact in organizations is obvious. However, there are still some challenges including: the lack of effectiveness, the

problems of decision makers' productivity despite of their willingness, the necessity of technologic supports to help mediated collaborative decision making, the decision monitoring, the knowledge capitalisation, and so on.

Some above identified problems have been addressed by Adla in his thesis titled "Aid to Facilitation for a Collective decision making: Proposition of a Model and a Tool" (Adla, 2010). This thesis proposes an approach in three phases, Pre-decision, Decision and Post-decision, for the collaborative decision making and an architecture for a cooperative system supporting this approach. Indeed, the needed phases for a collaborative decision making process execution require a system called GDSS (Group Decision Support System). That consists in collaborative systems with functionalities required to support the different steps.

In this context, this paper presents a study aiming to:

- identify collaborative systems for group decision making process,
- display comparative study of these tools,
- propose selection guide of collaborative tools for decision makers, especially facilitators.

The remain of this paper is organized as follow: the section 2 presents the decision making concept, the different types of tools used in decision making and an approach for collaborative decision making. The section 3 displays the state of the art on collaborative systems, and finally the section 4 presents the conclusion and further works.

2 Background

This section briefly describes in the literature GDSS. In next subsection, the different types of existing GDSS and their characteristics are presented.

2.1 GDSS types

The systems supporting decision making exist for several decades (years 1970) and they considerably evolved until now.

As an interactive system for decision making DSS (Decision Support System), the GDSS is designed to be a mean for the decision making in group context. There are two main categories of GDSS: some of them are called Face-to-Face systems and those are known as Interfaced Systems (Straub, Beauclair, 1988):

2.2 A Collaborative decision Making Process Model

The figure 1 presents an overview of the decision making process divided into the three phases previously presented (Pre-decision, Decision, Post-decision). A detailed presentation of each phases is made below.

- ***Pre-decision phase***

Here, the participants have to share understanding of the problem and the targeted objectives to attain. Since all participants have not the same background, nether the save information, this phase helps to get a common representation of the problem following different viewpoints. Behond the shared understanding of the decision space, the creation of the common operattive referencial is a main important step in this pre-decisionnal phase (de Terssac, Chabaud, 1990).

In other words, that consistes to define the limits and boundaries of the problem and decision space through the specification of the all caracteristics of the decision to make. This can be done with expressing the group expectations, defining the all stakeholders and the roles assigned to them, identifying thecnologies to use and the accuracy about the required functionalities and

their configuration, and finally creating an agenda.

This agenda presents an overview of the decision making process since the pre-decision phase. It contents the all required information for process conducting: brief description of each step, defining the objectives the steps, identifying participants and their role in each step and the duration of this step, etc.

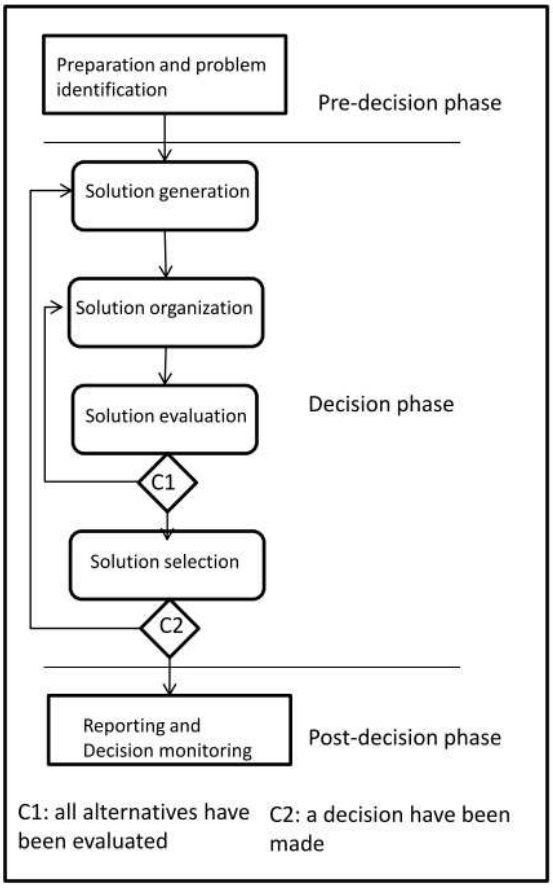

Figure 1: Process Model of collaborative decision making process. (Adla, 2010)

- ***Decision phase***

The decision phase is divided into four main steps that are ideas generation, organization, evaluation and then ideas selection. Each of these steps is presented below.

✓ Generating alternative solutions

During this step, the group products ideas in two times: individual production in a private space, then the group generates collectively in a public space. Indeed, each participant has to generate ideas that have to be published and elaborated by other participants. The benefit of this approach in double steps is to incite participants to personal and collective thinking in successive and recurrent way by allowing them to compare their ideas.

✓ Ideas organization

Once the ideas have been generated, they have to be organized in order to increase their visibility and understanding. So, ideas organization is required before to use them in one way or another.

In addition, since there are often redundant ideas, organization step allows merging similar contributions detected by the facilitator and participants. Tue use of a consolidated tool is required to facilitate the execution of this step.

- ✓ Evaluation des alternatives

When the propositions are organized, it is necessary to compare the different viewpoints in the common referential of the decision. But, it is asked to each participant to make effort for individual evaluation before to share them. A negotiation can then start in order to bring group to a convergent point accepted by everyone.

There are three available methods for estimation: (1) the analytical method which is supported by constraints evaluation depending to decision environment. The estimation (Nasir, 2006), the voting (Schapire et al., 1998) and the multicriteria evaluation (Davies, 1994) are some examples; (2) comparative evaluation approach which consists to put different alternatives facing each other in order to distinguish the similarities and differences. The ranking (Murphy, 1989) is an example of this type of methods; finally, (3) the analogical evaluation method (Privitera et al., 2003) which uses previously acquired knowledge in order to use them in a current situation and evaluate the solution.

The choice of these solutions depends on the situations and the decision makers involved according to their preferences. Thus, facilitator can suggests a method following the capabilities of used tool.

The evaluation results, i.e., the means, standard deviations, etc. are displayed for visualization. These results are interpreted and in case of contrast indicated by a high standard deviation, the facilitator intervenes to bring the group to a discussion phase for consensus. If necessary, this step can be re-executed until to get consensus. In this case, argumentations from group are constructed either by comparison (several alternatives), or by analogy (organizational memory), or even by authority (hierarchical reasons) (Adla, 2010).

- ✓ Decision/ Choice of solution

This step consists to clearly identify and publish the agreements from participants. This requires a negotiation phase. It is important to keep in mind that decision is context related, i.e., it makes sense only if we consider the context and reality under which decision has been made. For example, following elements have to be taken into account: objectives, constraints, resources and the criteria. In addition, in order that this shared context remains to be mutually understood, the decision has to be known by concerned actors. Thus, these actors have to be notified about all modifications concerning the decision made even if they are involved indirectly in the process. The benefit is to conserve the validity of the common operative referential.

- ***Post-decision phase***

This phase is very important because it allows the decision monitoring. Monitoring a decision consists essentially to realize an action planning (in general on shape of projects) in order to implement the decision made. The action plan gives information on people involved in the projects by specifying their roles and the calendar according to which these projects have to progress. The decision monitoring also concerns the experience capitalization in the organization. To do that, a knowledge base is built and regularly updated. For the organization, the benefits of this practice are to facilitate the definition of decision making problem similar to previous problems, and the generation of possible solutions of new problems.

This organizational memory can be used in different contexts which are (Adla, 2010): (i) a decision making process management tool, i.e., a way for participants to get visions and consistent orientations in complex process; (ii) a tool to facilitate the reuse, i.e., allow decision makers to query the knowledge base in order to check if there are similar problems already solved (retrospection) or allow the elaboration of currently useful solutions and also those likely to be later (prospection).; finally (iii) a tool for new knowledge construction, i.e., a way to evolve the knowledge acquired by organization toward an increased added value know-how. So, it is not

a accumulation of information in regular way, but it is a way to evolve knowledge consistently and harmoniously to give a new one which encompass the sum of previous ones.

As any decision making model, which is presented above is not a perfect model, but it is flexible and adaptable after the situations and the decision makers. The definition of current model takes into account the task and the process to which it belongs alternatively. The model also allows a distribution of decision makers into several decision groups, which can be preferable in the case of complex process requiring the participation of a large group. Thus, an environment offering the possibility to manage both the process and the task in order to attain the objectives is very desirable. That would facilitate the mutual regulation of decision related to process and those related to the task because both gives rise to final decision.

It is important to note that because of strong dependence of some steps, they are not sequential unlike their classical representation. For example, the problem evaluation and the elaboration of its solutions go hand in hand, that makes these steps implementation almost parallel. In addition, some steps can be implemented asynchronously and others require synchronous execution. Indeed, if we can admit that the ideas generation and organization are asynchronous, in reverse, it is preferable that the negotiation required in the evaluation and selection steps implements synchronously in order to facilitate these steps and to save time and finally to win effectiveness.

The construction of the organizational memory which has been previously apologized and its regular enrichment are one original point of the current model.

Moreover, the effectiveness of o decision making group does not depend only to the used process, but it also depends on an automated tool supporting the group activity. According to Denis et al., the use of a tool can reduce the working time to 50% and to cut the project time from 70% to 90% (Denis et al., 1990). On the basis of foregoing, we made a state of the art on systems supporting above process. These systems are presented in following section.

2.3 An architecture to the aid for collaborative and distributed decision making

The architecture presented here has been proposed by Adla et al. in which both cooperations are taken into account, i.e., Human-Machine cooperation and Human-Human cooperation. Below is a description of each cooperation type.

2.3.1 Types of cooperation

a. Human – System cooperation

The human, i.e. the decision maker in current case, is central to any decision process even if the use of a decision support system is sometimes necessary to increase performance of decision makers involved in the process. Thus, the system plays a cooperative role regarding the human who has master the system or at least to have useful knowledge tool using. Indeed, there are actions required by the system from the user so that the system reacts according to the user expectations. Coordinating actions between decision maker and the system is necessary in such a cooperative process. In other words, a set of rules that structure the cooperative action must be defined between the decision maker and the system. These rules take into account the used technology limitations.

Human – System cooperation is useful when the individual problems resolution phase made by each decision maker.

b. Mediated Human – Human cooperation

Since we are in the group decision-making situation and that it involves multiple decision makers simultaneously, a Human - Human dimension must be taken into account even if a system can be used. Indeed, the use of a system aims to facilitate and to make more effective the Human –

Human cooperation instead to replace this one. Therefore, the system should allow the emergence of a new form of interaction between participants that brings added value compared to an execution without the system. Mediating the decision making process provides to decision makers realtime or differed communication features, advanced computing devices that are only possible by technology, anonymity, increased interactivity, distribution in different geographic locations, etc. It should nonetheless be noted that the system is not suitable to all situations. In some cases, decision makers make use of traditional way without technology (Boehm et al., 2001).

This type of cooperation is implemented at group level during the consolidation phase following the initial one (individual decision making). The facilitator defines the process and the types of cooperation to apply as appropriate. The facilitator has to lead participants through the different steps toward the final decision which requires the participation of all.

2.3.2 An architecture

Based on the descriptions of cooperation types involved in the collaborative decision-making process, an architectural model of a system supporting this process is presented here. It is a centralized architecture. Indeed, such a model has the advantage of implementing simplicity, which also generates a time savings. In addition, such architecture is well suited to a process that gives particular place to the session facilitator. In fact, according to the process model proposed, when each decision maker has finished individual resolving, the group is led by the facilitator to make a collective decision. Figure 2 shows an overview of the global architecture. Individual decisions are made using specific cooperative decision support systems called DM-DSS. The facilitator also has a system for facilitating named F-DSS. An F-DSS is particularly useful for inexperienced facilitators.

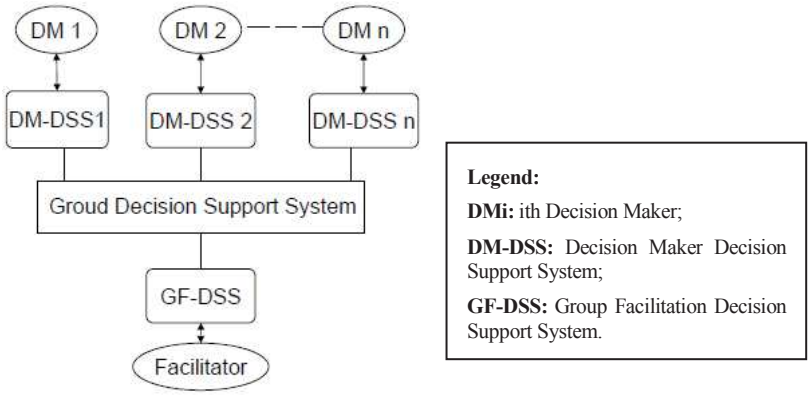

Figure 2: Architecture of a system for distributed decision making. (Adla, 2010)

Figure 3 shows the modules required in GDSS to support previously collaborative decision making approach presented.

1. A collaborative decision making process is based on techniques and tools supporting ideas generation (brainstorming, brainswriting, etc.), organization (categorization, classification, etc.), evaluation (multicriteria vote, etc.) and the ideas selection (negotiation, consensus building, etc.).

2. An agenda builder allowing session facilitator to prepare in advance the decision making meeting by specifying the steps and their goals.

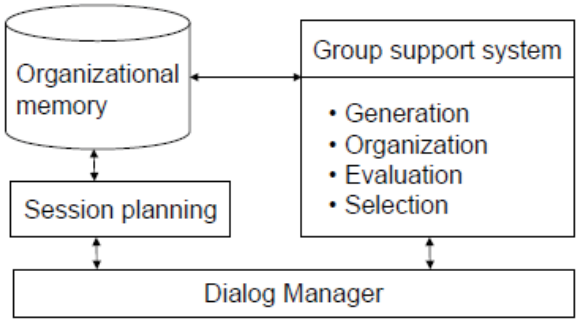

Figure 3: Outils d'aide à la décision de groupe (Adla, 2010).

3. A feature for the construction of collective and organizational memory. This memory is primarily a database containing all data (users, agenda, dates, generated ideas, evaluations, decisions, etc.) related to the previous sessions conducted by a group for traceability issues. Secondly, the memory stores the set of solutions to various cases of solved problems; this facilitates the reuse of solutions.

4. A communication manager between the decision makers. Such component allows interactivity which is required in collaboration. Web applications well support this interaction between users. Thus, they are successful examples for that so that the GDSS are increasingly modeled on Web applications.

The next section presents a set of collaborative tools (free or charged) supporting all or part of the collaborative decision-making process presented in this section. A comparison of these tools based on features they offer and the number of steps they support is also proposed. These tools almost implement in different ways the architecture presented in this section.

3 Collaborative Decision Making Tools: GDSS

There are several types of collaboration tools which support all or part of the decision making process from the problem formulation phase to solution choice phase.

According to Briggs, a tool supporting group work (decision making or other work) is a collection of tools for ideas generation which support several types of activities like voting (scales, multicriteria, etc.). Users can bring their contributions into a voting tool, evaluate them, and review instantly the results on line (Boehm et al, 2001). Most of tools allow the data sharing. Any user can contribute to shared list, any time and any contribution from a participant is visible instantly on other screens. All participants can simultaneously and freely contribute to discussion when he is inspired without wait for other people.

We present in the next subsection a set of tools that we identified and we propose a comparative table based on functionalities offered by these tools. This comparison is made either after using these tools or after demonstration meetings made by editor, or after reading tools presentation documents provided by tools editors. Several methods of test have been used.

3.1 Some GDSS tools presentation

All systems presented below do not require any set up technique because they are Web based applications. So, their use requires only internet connection and a Web browser. In this case, we consider the situation where the system is deployed on the editor server. But, if the user wishes to deploy the system on his own server for confidential reasons, it is necessary to make technical effort do satisfy this requirement.

1. **FacilitatePro:** this tool is a Web based application edited by Facilitate.com in USA

(Facilitate, 1992). It supports the three phases (pre-decision, decision, post-decision) of the decision process as presented in the methodology proposed the section 2.3. FacilitePro proposes supports to send electronic invitations to participants and also for problem definition, i.e., the collection of data from inquiries or precedent studies, critical problems identification, discussion and problems classification. The agenda creating which is part of the pre-decision phase is supported FacilitatePro. In the agenda, there are defined the decision making essential points. So, the participants can access to virtual space where they interact in asynchronous way to develop a shared understanding of the agenda. Once the problem definition is established and the agenda has been built, FacilitatePro also allows to present information to participants in a step just before the decision phase. In decision phase, this GDSS allows ideas generation anonymously according to user desire. Ideas so generated can be visualized by all participants and those can add comments with tool. It also offers the capability de create categories and to drag and drop ideas into categories. This tool allows voting and to immediately access to results. The results (including means and standard deviations) can be displayed on graphical or tabular shape. FacilitatePro offers functionalities to support the post-decision phase : action planning elaboration with a calendar for decision monitoring, and assigned responsibilities to different participants; the documenting of meeting can be made by generating report in different formats (words, html) can this report can be sent by Email; free access to virtual work space in asynchronous way is still possible after meeting in order to that participants can monitor the progression of decision execution and to prepare next meetings.

A simplified version of FacilitatePro is FacilitateExpress which supports the agenda creation, the generation, the categorization and the prioritization of ideas, and finally the reporting.

2. **Kindling:** this tool is also a Web based application developed by Arc90 organization (Arc90, 2004) in USA. In the phase of pre-decision, it supports the preparation of meeting by creating agenda, making electronic invitation and to access to virtual space for decision. Concerning decision phase, Kindling allows ideas generation in a common and shared space. It offers spaces dedicated to ideas generation called *rooms*. In these contextual spaces, we can classify ideas in specific themes. This is a way to early organize ideas since the generation phase. Kindling offers a functionality « Campaign » especially designed to support the group facilitator in particular when motivating participants to elaborate or comment ideas from other participants and to generate new ideas. The tool also supports the ideas rating according criteria in order to highlight the best ideas according to campaigns. It supports voting, ideas priorization and results analysis. The displaying of results can be made in graphical or tabular way. During the post-decision phase, there is the possibility to generate report with Kindling. Report can be exported into different formats like excel.

3. **ThinkTank:** this tool is one of the giants in the CSCW (Computer Supported Cooperative Work) field for several decades and edited by GroupSystem (GroupSystems, 1986) in USA. It supports pre-decision, decision and post-decision

phases of the collaborative decision making process. ThinkTank offers the functionalities for problem definition by collecting data from inquiries and preliminary discussion. It is also possible to create agenda with all information about meeting and to send electronic invitation to participants. This system offers to participants a forum for ideas generation. Ideas so generated are visible by participant who can elaborate or comment them. ThinkTank allows the creation of categories and ideas organization into categories. Voting (binary, decimal, multicriteria …) and the ideas prioritizing are also supported and instantly results presentation, analysis and synthesis. The results are displayed in graphic or tabular with means and standard deviations. In order to support the post-decision phase, Thinktank offers functionalities to create for action planning by assigning roles to participants and by defining calendar. This allows decision execution and monitoring. The meeting documenting is also possible par generating the report containing all details of the meeting and it can be recorded into different formats of file (Word, Html, Excel). Participants can access to virtual space for others activities in decision monitoring context.

4. **Grouputer:** this system is a Web based solution proposed by Grouputer (Grouputer, 1995) in Australia since 1995. It supports the phases before, during and after decision. Specifically, it allows meeting agenda building, defining process to be executed. Grouputer offers a common space for ideas generation, categorization, voting and prioritization. The tool also allows surveys. About post-decision phase, Grouputer offers capability to generate reports, establish an action plan for decision monitioring and to access in free way to virtual shared space.

5. **Webcouncil:** this Web based solution proposed by CoVision (Covision, 1985) which is also one leader in the group technologies market for some decades in USA. Webcouncil covers the upstream phase of decision making, the decision phase and the downstream phase of decision. It has several sophisticated functionalities to support a collaborative decision making process. Among these functionalities, there is agenda builder, a space for online information sharing between participants, electronic messaging invitation. The decision phase is supported by Webcouncil through features for brainstorming, commenting, organizing, voting (unique choice, rating, scaling, multicriteria) and prioritizing ideas. The results (including means and standard deviations) are viewable in different shapes (tables, graphics) in order to facilitate their interpretation.
   Webcouncil is also adapted to support decision monitoring phase because it allows generating report, action planning with calendar and assigning tasks to responsible. The access to virtual space in order to share information and to consult them is also possible.

6. **Brightidea:** this system is a product of Brightidea organization (Brightidea, 1999) in USA. It clearly makes distinction between phases of decision making process and it has appropriate functionalities to support each step. So, the pre-decision phase is supported by WebStorm which allows meeting preparation by creating a virtual space and to send electronic invitation. WebStorm also supports ideas generating, organizing and voting. Ideas evaluation and results analysis are made with SwitchBoard which another available

features of Brighidea. Several evaluation methods are offered by this system, especially multicriteria voting. Results can be displayed in a graphic or a table. The post-decision phase is supported by another feature of Brightidea called Pipeline which offers functionalities for action planning and to monitor decision in the context of projects. Brightdea allows reporting in formats like word.

7. **Ideascale:** developed by the society Ideascale (Ideascale, 2003), this tool is Web based solution dedicated to collaboration between product developers and their clients in order to better reply to their needs. Therefore, it is a decision making support in that it allows users to make decisions for improvement of the quality of services provided by products developers and for customer satisfaction. It supports some steps of pre-decision, decision and post-decision phases. In pre-decision phase, the tool allows to send electronic invitation to participants by explaining the theme and the objective of the meeting, and the URL to access to virtual space for decision making. Thus, participants can access asynchronously to learn more about meeting. Ideas generation and their commenting are possible in the dedicated forum. Ideas so generated can be organized by categories, evaluated through voting and prioritizing. The results analysis is supported by Ideascale which also allows displaying in numerical our graphical shape. Ideascale supports the post-decision phase by allowing access to virtual space to view activities and their results; it also allows reporting par mail. Even if Ideascale is freeware, some advanced functionalities are not free.

8. **Dialogr:** it is also a Web based solution developed by Dialogr.com (Dialogr, 2007) for collaborative decision making. In free access, Dialogr allows to support some steps of the three phases of decision making process. In the phase of pre-decision, it is possible de send electronic invitations to participants with the URL of the virtual space and also comment about the objective of the meeting. Thus, participants can access to thus space to get information and to prepare the meeting. The decision phase is supported by Dialogr through its capability for ideas and comments generation, ideas evaluation by rating them with stars (five stars maximum) and the ideas prioritization. There is a minimalist analysis because it is not possible to make calculus of means, standard deviations and to display them in tables or graphics. So, Dialogr is more appropriate decision making tool for relatively simple problems and in which the consensus does not require many factors. A report can be sent to group members by Email when decision is made. The free access to virtual space is possible for decision monitoring and others information sharing.

9. **JamespotPro:** this tool is another Web based application which is proposed by the organisation Jamespot.com (Jamespot, 2005). It is also suited to collaborative decision making in organisations and it supports some steps of the three phases of the process presented in section 2. In the pre-decision phase, JamespotPro allows to define agenda and to invite participants through Email. About the decision phase, the ideas generation and their organisation are supported by this application. The post-decision phase is possible by generating reports from preceding phases and to build a calendar associated to actions people have to do and the execution dates. In addition, it is possible to access

to access to decision space for monitoring.

10. **Campfire:** this tool is Web based application suitable to collaborative decision making. It is a solution from Campfire (Campfire, 1999) and it supports some steps of the process presented in previous section.

    Campfire supports the pre-decision phase by allowing meeting preparation and sending invitation to participants. It has not advanced functionalities for data analysis because it is essentially focused on data collection. Campfire allows report generation and access to forum for decision monitoring. Campfire is freeware for small size of group and its price increases according to group size.

11. **BrainReactions:** this Web application provides basics for decision making process. It is a solution from BrainReactions (BrainReactions, 2005) which supports following steps of the process presented in section 2: the meeting preparation phase through creating decision making virtual space and sending electronic invitations to participants. Ideas generation is supported by BrainReactions and it allows voting and organizing ideas. There are not approciate functionalities for results analysis. The decision monitoring is possible by accessing to decision forum after decision phase.

12. **CentralDesktop:** this system is a Web based application proposed by Central Desktop (Central Desktop, 2005). It mainly supports the pre-decision phase by allowing creating virtual space for meeting, agenda building and electronic invitations sending to participants. The decision phase is partly supported because CentralDesktop does not sustain ideas generation and their categorization according the topics. Concerning the post-decision phase, it is possible to send report by Email and to access to decision space for monitoring.

13. **MeetingWorks:** this system is a Web based solution developed by IBM (Meetingworks, 1994) and which is actually less and less used. However, MeetingWorks is a tools suite supporting all steps of three phases of collaborative decision making process. It offers features for agenda building, electronic invitations and other steps of pre-decicionnal phase. One of its features allows following the progress of different steps defined in agenda by displaying the time during process execution. Ideas generation, organization and evaluation are also sustained by functionalities of MeetingWorks. Cross-analysis and multicriteria analysis of the results are supported by this tool and their displaying in shape of graphic and tabular. The analysis feature allows two levels in sense making: individual and collective levels. Generating and managing reports is possible in MeetingWorks as well as all steps in the post-decision phase, especially decision monitoring. This system has other interesting functionalities for decision making such as timer, document loader, etc.

14. **Expert Choice:** this tool is a solution from ExpertChoice (Expertchoice, 1983) founded in 1983. ExpertChoice tool is powerfull in decision making especially in ideas evaluation step by using multiple criteria based on Analytic Hierarchy Process (AHP). However, this system is not effective for data collection, analysis, clarification and the reduction of

a large number of ideas. The post-decision phase is possible through an access to data, report generation and decision monitoring.

3.2 Collaborative Tools Comparison based on functionalities

The table 2 displays an overview of tools previously presented according to some criteria based on functionalities and steps they support during each phase of decision making process. The table also allows a comparison of the different tools to help users to make choice according to their needs if criteria we defined make sense for them. Each of these tools can be used for decision making meeting either in synchronous or asynchronous way, and also either in same or different places.

It is important to note that this evaluation is not a judgment on tools. However, our evaluation proposes appreciation elements by using rating scale (very unsatisfactory, unsatisfactory, satisfactory, and very satisfactory) to measure the elaboration level of each functionality depending on tools. When a functionality is very unsatisfactory (--), it does not exist or almost. When a functionality is unsatisfactory (-), that means it is not well elaborated. If a functionality is qualified as satisfactory (+), this functionality exists and it works well. Finally, when a functionality is very satisfactory (++) in a given tool, that means this tool supports functionality in effective way.

				Pre-decision		Decision				Post-decision		
Functionalities / Tools	Time Management	Organisational Memory	Anonymity	Agenda Builder	Electronic Invitation	Brainstorming	Organization	Prioritizing/ Voting	Results Analysis	Actions planning	Documenting	Decision Monitoring
Dialogr	--	+	--	--	+	+	-	+	-	--	-	-
FacilitatePro	-	++	++	++	++	++	++	++	++	++	++	++
Kindling	-	+	-	+	++	++	++	++	++	++	++	++
ThinkTank	-	++	++	++	++	++	++	++	++	++	++	++
Ideascale	--	+	--	--	+	+	+	+	-	--	+	+
Brightidea	-	++	-	-	++	++	++	++	++	+	++	+
JamespotPro	--	+	-	--	+	+	-	-	-	--	-	-
Campfire	--	+	--	-	++	+	-	--	--	-	-	-
Webcouncil	-	++	++	++	++	++	++	++	++	++	++	++
BrainReactions	--	+	--	--	+	++	-	-	--	--	-	-
CentralDesktop	--	+	--	-	++	+	+	--	--	+	+	-
MeetingWorks	++	++	++	++	++	++	++	++	++	++	++	++
ExpertChoice	--	+	--	--	--	--	--	++	+	--	+	+
Grouputer	-	+	++	++	++	++	++	++	++	++	++	+

Legend

Symbols	--	-	+	++
Signification	Very unsatisfactory	Unsatisfactory	Satisfactory	Very satisfactory

Tableau 2: Comparative table of collaborative tools decision for making process.

3.3 Discussion

It is important to note that there are tools on the market that address certain steps of collaborative decision making process. These tools sometimes called as GDSS and indeed they may be

collaborative tools. Since these systems are not necessarily complete tools suite, and subsequent or prior steps of a decision-making process would require the integration of other features into process. So there would be no concept of an integrated flow of information from one step of the process to another or movement of people and their thinking from one step of the process to another (Collins, 2010).

Each of above tools has functionalities supporting all or important part of decision making process. They are proven tools that most of them are from market and used by great companies and universities.

The effective use of these tools requires facilitators who master them and who are able to bring decision making team their goals through a given process.

4 Conclusion

This paper presents fourteen (14) tools supporting collaborative work. The main functionalities of these systems have been identified, in particular functionalities sustaining the steps of collaborative decision making process. A comparative study on these tools is made in order to highlight their strengths and weaknesses according to the steps of process. Thus, decision makers can use the comparative table as selection guide to choose their GDSS and to build their process.

The paper also considers a decision making approach that has been proposed in previous research works. This methodology has three phases: pre-decision, decision and post-decision.

One of the principle objectives of this approach is the *knowledge capitalization*. Even if some of the systems we identified allow backup and archiving data from previous decision making sessions, none of them really implement a specific functionality for consistence and dynamic organisational memory building. Indeed, the systems do not build new knowledge from existing ones. However, knowledge capitalization for organisational memory is a progressive construction of new knowledge from those already acquired and those being acquired in the coherence to be used for solving future problems.

Thus, our works perspectives include: more studies on GDSS in order to increase their performance and efficiency in decision making by adding features such as real-time display of time that elapses during the meetings, the capitalization of knowledge based on Ontologies, etc. In addition, other studies can be conducted to develop approaches for collaborative decision-making by taking into account the limits of technology.

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